WHAT IS CLAIMED IS:

1. A gas-based cryotherapy probe comprising:

a shaft having a closed distal end adapted for insertion into a body;

a supply conduit disposed longitudinally within the shaft for flowing gas towards the distal end;

a return conduit disposed longitudinally within the shaft for flowing gas from the distal end, the gas being maintained at a lower pressure within the return conduit than in the supply conduit;

a heat exchanger disposed within the shaft in thermal communication with the supply conduit and return conduit to exchange heat from gas in the supply conduit to gas in the return conduit; and

a vacuum jacked adapted to provide thermal isolation of the heat exchanger from the shaft.

2. The gas-based cryotherapy probe recited in claim 1 wherein the heat exchanger comprises a plurality of strips of high-thermal-conductivity material in contact with the supply conduit and extending towards the return conduit.

3. The gas-based cryotherapy probe recited in claim 1 wherein the shaft comprises a nonmagnetic body and a metallic tip at the distal end of the shaft.

4. The gas-based cryotherapy probe recited in claim 1 wherein the shaft further has a plurality of injection ports for injection of fluids.

5. The gas-based cryotherapy probe recited in claim 1 further comprising electrical wiring disposed within the vacuum jacket.

6. The gas-based cryotherapy probe recited in claim 5 wherein the electrical wiring comprises multifunction electrical wiring configured to permit multiple-point temperature monitoring of the distal end.

7. The gas-based cryotherapy probe recited in claim 6 wherein the multifunction electrical wiring is configured to provide electrical stimulation of the body.

8. The gas-based cryotherapy probe recited in claim 1 further comprising a Joule-Thomson port disposed in the distal end of the shaft and thermally coupled with the heat exchanger.

9. The gas-based cryotherapy probe recited in claim 1 wherein the heat exchanger comprises a plurality of strips of high-thermal-conductivity material in contact with the supply conduit and extending towards the return conduit.

10. A gas-based cryotherapy probe comprising:

a shaft having a closed distal end adapted for insertion into a body;

a supply conduit disposed longitudinally within the shaft for flowing gas towards the distal end;

a return conduit disposed longitudinally within the shaft for flowing gas from the distal end, the gas being maintained at a lower pressure within the return conduit than in the supply conduit; and

a heat exchanger disposed within the shaft in thermal communication with the supply conduit and return conduit to exchange heat from gas in the supply conduit to gas in the return conduit, the heat exchanger comprising a plurality of strips of high-thermal-conductivity material in contact with the supply conduit and extending towards the return conduit.

11. The gas-based cryotherapy probe recited in claim 10 wherein the shaft comprises a nonmagnetic body and a metallic tip at the distal end of the shaft.

12. The gas-based cryotherapy probe recited in claim 10 further comprising multifunction electrical wiring disposed within the shaft and configured to permit multiple-point temperature monitoring of the distal end.

13. The gas-based cryotherapy probe recited in claim 10 further comprising a Joule-Thomson port disposed in the distal end of the shaft and thermally coupled with the heat exchanger.

14. A liquid-based cryotherapy probe comprising:

a shaft having a closed distal end adapted for insertion into a body and having a hollow zone within the shaft;

a thermally isolated inlet capillary in fluid communication with the hollow zone for providing a flow of liquid towards the hollow zone;

an outlet capillary in fluid communication with the hollow zone for providing a flow of liquid away from the hollow zone; and

a vacuum jacket adapted to provide thermal isolation of the inlet and outlet capillaries within the shaft from the shaft,

wherein an average cross-sectional area of the output capillary is greater than an average cross-sectional area of the input capillary.

15. The liquid-based cryotherapy probe recited in claim 14 wherein the shaft comprises a nonmagnetic body and a metallic tip at the distal end of the shaft.

16. The liquid-based cryotherapy probe recited in claim 14 wherein the shaft comprises a plurality of injection ports for injection of fluids.

17. The liquid-based cryotherapy probe recited in claim 14 further comprising electrical wiring disposed within the vacuum jacket.

18. The liquid-based cryotherapy probe recited in claim 17 wherein the electrical wiring comprises multifunction electrical wiring configured to permit multiple-point temperature monitoring of the distal end.

19. The liquid-based cryotherapy probe recited in claim 19 wherein the multifunction electrical wiring is configured to provide electrical stimulation of the body.

20. A method for cooling material, the method comprising:

positioning an end of a cryoprobe in the material;

circulating a cryogenic liquid through the cryoprobe under physical conditions near a critical point of a liquid-vapor system for the cryogenic liquid,

whereby vapor lock associated with cooling of the cryoprobe is avoided.

21. The method recited in claim 20 wherein the cryoprobe has a diameter less than 2 mm.

22. The method recited in claim 20 wherein the cryoprobe has a diameter less than 1 mm.

23. The method recited in claim 20 wherein the cryogenic liquid is liquid nitrogen and the physical conditions comprise a pressure of about 33.5 atm.

24. The method recited in claim 20 wherein the material comprises an imaging array.

25. The method recited in claim 20 wherein the material comprises electronic circuits in a device.

26. The method recited in claim 20 further comprising:

positioning an end of a second cryoprobe in the material, the ends of the cryoprobes being made of an electrically insulating material; and

electrically ablating the material by forcing current between the ends of the cryoprobes to heat intervening material.

27. The method recited in claim 26 wherein electrically ablating the material is performed after circulating the cryogenic liquid through the cryoprobe for initial ice formation.

28. The method recited in claim 20 further comprising injection a cryosensitizing substance into the material with the cryoprobe.

29. A flow port comprising:

a structure defining an orifice through which material may flow; and

a high-yield-strength wire disposed within the orifice and adapted to vibrate in response to a flow of material through the orifice.

30. The flow port recited in claim 29 wherein the orifice is adapted to support high-Reynolds'-number flow patterns.

31. The flow port recited in claim 29 wherein the flow port forms part of an engine fuel injector.

32. The flow port recited in claim 29 wherein the flow port forms part of a chemical spray nozzle.

33. The flow port recited in claim 29 wherein the flow port forms part of a fluid jet.

34. The flow port recited in claim 29 wherein the flow port forms part of a natural-gas purification device.

35. A method for determining a temperature within a body, the method comprising:

supplying a measurement current to a wire within the body;

measuring a forward voltage while holding the measurement current substantially constant;

reversing a direction of the current by applying a negative of the measured forward voltage to the wire;

measuring a reverse voltage while the direction of the current is reversed;

determining a resistance of the wire from the measured voltages to account for a thermal electromotive force differential associated with measurement leads in electrical communication with the wire;

and determining the temperature from the determined resistance and a calibrated variation of resistance with temperature.

36. The method recited in claim 35 wherein the wire is comprised by a cryotherapy probe having a shaft with a closed distal end adapted for insertion into the body, conduits for flowing cryogenic fluid within the shaft, and a post disposed within the closed distal end, the wire forming a plurality of turns about the post.

37. The method recited in claim 35 wherein the wire is comprised by a probe containing at least one temperature measuring point.